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54. TYPE DISCRIMINATION APPARATUS OF DOCUMENTS COUNTER

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SPECIFICATION

1. TITLE OF THE INVENTION:

TYPE DISCRIMINATION APPARATUS OF SHEETS COUNTER

2. CLAIM

(1) A type discrimination apparatus of a sheet counter for separating a single sheet from a stack of sheet one by one and transporting them at predetermined intervals and counting a number of the sheets during the process of the transportation, characterized in that a width of the sheets in a direction being at right angles to a transportation direction is detected optically and a type of the sheets is discriminating based on the detection.

3. DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a type discrimination apparatus of a sheets counter, more specifically relates to a type discrimination apparatus of a sheets counter for separating a single sheet from a stack of sheet one by one utilizing a friction or absorption, and transporting them by means of a belt or the like at a predetermined intervals so as to count a number of the sheets mechanically or electrically during the process of the transportation.

Such a kind of a sheets counter could not discriminate a type of sheets because its counting operation is performed at a high speed or due to a problem of accuracy. For this reason, in the case where a different type of sheets are mixed in sheets to be counted, the different type of sheets are counted as regular sheets. Therefore, an operator should visually check counted sheets, and thus the work becomes complicated.

The present invention has been achieved in view of such defect, and a first object of the invention is to provide a type discrimination apparatus which has simple structure and executes discrimination accurately and at a high speed. Moreover, a second object of the invention is that a different type of sheets can be discriminated by a type discrimination apparatus, and when a different type of sheets are transported, the counting can be stopped or the different type of sheets can be rejected. Further, a third object of the invention is that a number or the like per type can be calculated by utilizing type discrimination outputs of the type discrimination apparatus.

In order to achieve the objects, the type discrimination appratus of the present invention optically detects a width of sheets in a direction being at right angles to a direction of transportation of the sheets, and discriminates a type based on the detection.

There will be described below one embodiment where the present invention is applied to a friction-type sheets counter.

(1) Outline of the Embodiment

Fig. 1 shows a mechanism section 2 of a paper currency

counter according to the present embodiment, and Fig. 2 shows a circuit section 3 of the paper currency counter according to the present embodiment. In Figs. 1 and 2, the paper currency counter of the present embodiment is composed of the mechanism section 2 and circuit section 3. The mechanism section 2 is composed of a sheet feeding mechanism 4, a separating mechanism 5, a transporting mechanism 6, a reject mechanism 7, an stacking wheel 8, a main body case 9 for storing these sections and the like. When a stack of paper currency is placed on the sheet feeding mechanism 4, the stack of paper currency is fed to the separating mechanism 5 one by one so as to be transported one by one to the transporting mechanism 6 on the next stage at predetermined intervals. The transporting mechanism 6 not only transports the paper currency but also detects various errors of the transporting paper currency by means of a sensor section 10. When no error occurs, the paper currency is transported to the stacking wheel 8, and the paper currency is re-stacked in an stacking box 11. On the other hand, when an error occurs, the transporting paper currency is not transported to the stacking wheel 8 but transported to a reject box 12 by the reject mechanism 7.

The circuit section 3 is composed of the sensor section 10, a detection section 13, a detected output processing section 14, an amount operation/display section 15, a reject driving section 16 and the like. When paper currency is transported by the transporting mechanism 6, the sensor section 10 generates various sensor outputs according to a width of the paper currency or the like, and the detection section 13 generates a type discriminating signal JUD, a width abnormal signal WID, an inclined transportation signal AFD and the like according to the sensor outputs. When an amount display mode is selected by operating a mode switch 17, the amount operation/display section 15 displays and prints numbers and amounts of respective types based on the output signals of the detection section 13. On the other hand, when a different type detection mode is selected, the reject driving section 16 drives the reject mechanism 7 so

as to reject a different type of paper currency.

(2) Constitution of the Mechanism Section 2

The following will describe a constitution of each section. At first, the description will be given as to the mechanism section 2. In Fig. 1, as mentioned above, the mechanism section 2 is composed of the paper feeding mechanism 4, separating mechanism 5, transporting mechanism 6, reject mechanism 7, stacking wheel 8 and the like. The paper feeding mechanism 4 is composed of a paper feeding pedestal 18 and a kick-out roller 19. A through hole 20 is provided in the paper feeding pedestal 18, and the kick-out roller 19 is projected from a lower side of the paper feeding pedestal 18 to its upper surface slightly via the through hole 20. The kick-out roller 19 is mounted eccentrically to a shaft which rotates in a clockwise direction of Fig. 1, and a surface of the kick-out roller 19 is formed by rubber or the like having large frictional characteristics into an uneven shape. When a stack of paper currency is placed on the paper feeding pedestal 18, the paper currency is transported to the separating mechanism 5 by means of the kick-out roller 19 with it being regulated by a regulating plate 21.

The separating mechanism 5 is composed of a feeding roller 22, a pressing roller 23, a first braking member 24 and a second braking member 25. Similarly to the kick-out roller 19, the feeding roller 22 is formed by rubber or the like into an uneven shape. When about two or three pieces of paper currency are simultaneously fed from the paper feeding mechanism 4, the separating mechanism 5 separates them one by one so as to transport them to the transporting mechanism 6 successively. Here, the pressing roller 23 is supported to an arm 26 rotatively, and the arm 26 is urged to a counterclockwise direction of Fig. 1 by a coil spring or the like. At the state of emergency, for example, the jam recovery, the arm 26 can be moved back to the clockwise direction.

The transporting mechanism 6 is composed of transporting rollers 27, accelerating rollers 28, a guide 29 and the like. One of the transporting rollers 27 and one of the accelerating

rollers 28 (lower rollers) are driving rollers, and the other rollers of them are rotatively supported to an arm 30 by means of a shaft. The arm 30 can be evacuated pivotally about the shaft of the feeding roller 22 in the clockwise direction of the drawing. Therefore, if jam occurs during the transportation of the paper currency, the arm 30 is evacuated so that the jammed paper currency can be removed.

The paper currency transported from the separating mechanism 5 is transported to the transporting rollers 27 and to the accelerating rollers 28 along the guide 29, and the intervals between the paper currency is widened so that the paper currency is transported to the stacking wheel 8. Moreover, the guide 29 is provided with the sensor section 10 at a position of its inlet side and with a reject fork 31 at a position of its outlet side. The sensor section 10 and reject fork 31 will be described later.

The stacking wheel 8 has a plurality of vane 32, and the transported paper currency is sandwiched between the vanes 32, and the transported paper currency is stacked into the stacking box 11 regularly and successively.

The reject mechanism 7 is composed of the reject fork 31, a transporting roller 33, a transporting belt 34 and the like. The reject fork 31 is rotatively supported to a predetermined position, and is urged to the counterclockwise direction of the drawing in a normal state by a coil spring or the like. When a fork solenoid 35 (see Fig. 2), mentioned later, is driven, the reject fork 31 is rotated in the clockwise direction from the position shown in Fig. 1 against an elastic force of the coil spring or the like.

Here, in the state shown in Fig. 1, the transported paper currency is fed to the transporting belt 34 via the reject fork 31, and is fed to the reject box 12.

(3) Constitution of the Sensor Section 10 and Principle of the Type Discrimination

The following will describe the sensor section 10 and then the principle of the type discrimination. Fig. 3 shows an

arrangement of various sensors of the sensor section 10, and Fig. 4 shows an arrangement of right and left photo-diode arrays 37 and 38 composing a type discrimination sensor 36 (see Fig. 2). In Fig. 3, the the sensor section 10 is composed of the right and left photo-diode arrays 37 and 38, a length detection sensor 39, an optical double feeding detection sensor 40, skewed feeding detection sensors 41 and 42, and a timing generation sensor 43. The sensors 37 through 43 of the sensor section 10 are, as mentioned above, provided in the position on the inlet side of the guide 29, and in the arrangement shown in Fig. 3. The right and left photo-diode arrays 37 and 38 are placed on both side ends of the guide 29, and they are composed respectively of sixteen photo-diodes arranged in a direction being at right angles to a paper currency transportation direction (shown by an arrow) as shown in Fig. 4.

In Fig. 2, the sensor outputs of the sensor section 10 mentioned above are transmitted to the detection section 13, a timing pulse generating section 44 or the reject driving section 16. Namely, the sensor output of the type discrimination sensor 36 is transmitted to a type discriminating section 45, and sensor outputs of the skewed feeding detection sensors 41 and 42, the length detection sensor 39, the double feeding detection sensor 40, the timing generation sensor 43 and a reset sensor 46 are transmitted to an skewed feeding detecting section 47, a half-paper/linked paper detecting section 48, the optical double feeding detecting section 49, a timing pulse generating section 44 and a reject fork driving control section 50, respectively.

The timing pulse generating section 44 generates various timing pulses TP1, TP2, TP3, TP4 and TP5. Namely, every time paper currency covers the timing generation sensor 43, the timing pulse generating section 44 generates the timing pulses TP1 through TP5 successively. The timing pulses TP1 through TP5 are transmitted to various circuits.

There will be described below the principle of the type discrimination according to the present embodiment. The type discrimination is executed by detecting a width of paper currency

(shown by $\ell$ in Fig. 4). The width is discriminated in such a manner that some photo-diodes of the right and left photo-diode arrays 37 and 38 are covered by the paper currency. In the present embodiment, when the intervals between the photo-diodes of the photo-diode arrays 37 and 38 and the interval between the photo-diode arrays 37 and 38 are determined, in the case where paper currency is a ten-thousand yen bill, the twenty-two or twenty-three photo-diodes are covered by the paper currency. When a ten-thousand yen bill is transported as represented by an alternate long and short dash line in Fig. 4, for example, the ten photo-diodes of the left photo-diode array 37 and the twelve photo-diodes of the right photo-diode array 38 are covered by the paper currency as shown in Fig. 4. In the similar manner, in the case where the paper currency is a five-thousand yen bill, twenty or twenty-one photo-diodes are covered, and in the case where the paper currency is a thousand yen bill or five-hundred yen bill, the eighteen or nineteen photo-diodes and the sixteen or seventeen photo-diodes are covered respectively.

Outputs of the photo-diode arrays 37 and 38 are according to the width of paper currency as mentioned above, and the outputs are transmitted to the type discriminating section 45 as the sensor outputs of the type discrimination sensor 36.

Here, such type discrimination cannot be executed accurately when paper currency is transported in skew condition. Moreover, as shown by an alternate long and two short dashes line in Fig. 4, when paper currency is transported in a condition that the paper currency is put aside, and thus the paper currency exceeds a detection range of the photo-diode arrays 37 and 38. Furthermore, the paper currency is a half bill and linked, accurate discrimination cannot be executed. In the present embodiment, countermeasures against these problems are taken in such a manner that the discrimination is corrected and an error signal is generated. This point will be mentioned later.

(4) Constitution of the Detection Section 13

The following will describe the detection section 13.

In Fig. 2, the detection section 13 is composed of the type

discriminating section 45, the skewed feeding detecting section 47, the half paper/linked paper detecting section 48 and the double feeding detection section 49. The type discriminating section 45 generates type signals JUD1 through JUD4 based on the sensor output of the type discrimination sensor 36 and the timing pulses TP1, and detects and stores a width abnormal signal WID of a lengthwise direction of the paper currency and a skewed transportation signal AFD at a timing of the timing pulse TP1, and the type discriminating section is reset by a timing pulse TP5. The constitution of the type discriminating section 45 will be detailed in (8) later.

The skewed feeding detecting section 47 detects a time required while one of the skewed feeding sensors 41 and 42 is covered and both of them are covered based on the sensor outputs of the sensors 41 and 42 so as to detect skewed feeding. The skewed feeding detecting section 47 performs the following three operations according to skew of the transporting paper currency.

(a) In the case where even if an observed length is slightly changed according to the skew, a type of the paper currency can be discriminated without correction because a degree of the skew is small, the skewed feeding detecting section 47 generates no error signal.

(b) In the case where a type of the paper currency cannot be discriminated without the correction because a degree of the skew is slightly large, the skewed feeding detecting section 47 transmits a correcting signal Comp to the type discriminating section 45 so that accurate correction is executed. This point will be detailed below.

(c) In the case where a type cannot be discriminated accurately by correction because a degree of the skew is too large, the inclination abnormal signal ASF is set at the timing of the timing pulse TP1 so as to be transmitted to a latch timing control section 52 and a gate control section 53 via an OR circuit 51 as an error signal ERR, and then is transmitted to the reject driving section 16 via an OR circuit 54. The skew abnormal signal ASF is reset by the timing pulse TP5.

Here, the abnormal signals WID and AFD and a length abnormal signal LNG, mentioned later, and a double feeding signal DBL as well as the inclination abnormal signal ASF are transmitted to each section via the OR circuit 51 as error signals ERR.

The following will describe the half paper/linked paper detecting section 48 and the like. The half paper/linked paper detecting section 48 detects a time that the sensor 39 is covered by paper currency during the timing pulses TP1 and TP5. Then, the half paper/linked paper detecting section 48 judges as to whether or not the paper currency has a length in a predetermined range based on the detected time, and when the length is abnormal, the half paper/linked paper detecting section 48 outputs a length abnormal signal LNG at the timing of the timing pulse TP1, and the half paper/linked paper detecting section 48 is reset the signal at a timing of the timing pulse TP2.

In addition, the optical double feeding detecting section 49 detects double feeding of paper currency based on the output from the double feeding detection sensor 40 and the timing pulses TP1 and TP2. Namely, the optical double feeding detecting section 49 detects a transmitted light amount of the paper currency positioned in the sensor 40 at the timing of the timing pulse TP1, and when the transmitted light amount is not more than a reference level, it outputs a double feeding signal DBL. The optical double deeding detecting section 49 is reset by the timing pulse TP5.

In addition, an output of the reset sensor 46 is transmitted to the reject driving section 16 as a reset signal, and the output returns the reject fork 31 and releases locking of the fork 31 at the time of the rejection.

(5) Constitution of the Detected Output Processing Section 14

The following will describe the detected output processing section 14. In Fig. 2, the detected output processing section 14 is composed of a reference type setting input section 55, a reference type setting section 56, a different type detecting section 57 and latch timing control section 52. The reference

type setting input section 55 presets a reference type before counting, and setting input signals BSI1 through BSI4 are transmitted to the reference type setting section 56. Here, in the case where paper currency to be counted first is set as reference type paper currency, a latch signal TPL from the latch timing control section 52 is transmitted to the reference type setting section 56, and one of the type signals JUD1 through JUD4 is latched.

The latch timing control section 52 discriminates the first paper currency which is normally transported, and generates a latch signal TPL at a timing that the first paper currency is set and stored as reference type paper currency. Namely, when a counting start signal CST is inputted into the control section 52 and an error signal ERR is not inputted thereinto, the control section 52 outputs a latch signal TPL to the reference type setting section according to the timing pulse TP2 inputted first. For this reason, in the case where a reference type is set by the first timing pulse TP2 which is generated after the counting starts, even if the width of the first paper currency is abnormal and the skew occurs, there is no fear that a type which is different from a type of actual paper currency (observed type) is set as the reference type. Therefore, there is no disadvantages that a small piece of a mixed different type of paper currency is counted as a normal type and the other hand, most pieces of paper currency is rejected.

The different type detecting section 57 discriminates as to whether or not a type of transported paper currency is a different type based on discrimination signals JUD1 through JUD4, reference type signals BST1 through BST4 and timing pulses TP3 and TP5. When the transported paper currency is paper currency of a different type, the different type detecting section 57 stores and outputs a different type signal DIF at a timing of the timing pulse TP3. The different type signal DIF is reset at the timing of the timing pulse TP5. The different type signal DIF is transmitted to the reject driving section 16 via an AND circuit 58 and OR circuit 54 and transmitted directly to the gate

control section 53.

(6) Constitution of the Reject Driving Section 16

The reject driving section 16 is composed of a reject fork driving control section 50, an AND circuit 59 and a flip-flop 60. The reject fork driving control section 50 actuates the fork solenoid 35 at the timing of the timing pulse TP5 except when a lock signal LOCK, mentioned below, is inputted. Therefore, when the lock signal LOCK is not generated, the reject fork 31 (see Fig. 1) is urged to the clockwise direction in Fig. 1, and thus paper currency is transported towards the stacking wheel 8.

In the case where an error signal ERR or a different type signal DIF is inputted, the flip-flop 60 stores an error at a timing of the timing pulse TP4 and transmits the lock signal LOCK to the reject fork driving control section 50. When a lock signal is generated, the driving control section 50 cancels the timing pulse TP5 so as not to actuate the fork solenoid 35. Therefore, at this time, the transported paper currency is rejected. Moreover, the flip-flop 60 is reset by a reset signal RST so that the lock signal LOCK is cleared. Further, the reject fork driving control section 50 also release magnetization of the fork solenoid 35 according to the reset signal RST.

(7) Constitution of the Amount Operation/Display Section 15

The amount operation/display section 15 is composed of the gate control section 53, a number counting section 61, an operation section 62, an addition section 63, a display section 64 and a print section 65. The gate control section 53 has gates for respective types of paper currency, and gates the timing pulse TP3 based on the discrimination signals JUD1 through JUD4, mode signals TPM and OKM, error signal ERR and different type signal DIF.

Namely, the detection mode is set as an amount operation mode, and thus in the case where the mode signal TPM is inputted into the gate control section 53, the gate control section 53 obstructs a gate of the timing pulse TP3 only when the error signal

ERR is generated, and on the other hand, in a state other than this, it transmits the timing pulse TP3 to the number counting section 61 via a gate of a discriminated type. On the other hand, in the case where the detection mode is set as a different type detection mode and thus another mode signal OKM is inputted into the gate control section 53, when not only the error signal ERR but also the different type signal DIF is generated, the gate control section 53 obstructs the gate of the timing pulse TP3, and on the other hand, in a state other than the above, the gate control section 53 transmits the timing pulse TP3 to the number counting section 61 via a gate of a discriminated type. The pulse TP3 which was gated in such a manner is transmitted as a counting pulse to the number counting section 61 directly or via the OR circuit 66.

The number counting section 61 counts the timing pulses TP3, which are gated per money type from the gate control section 53 as mentioned above, individually per money type. Moreover, the number counting section 61 counts the timing pulse TP3 from the OR circuit 66, namely, a pulse according to a total number. Various counted outputs of the number counting section 61 are transmitted to the operation section 62, display section 64 and print section 65. Numbers for respective denominations and a total number of paper currency held in the display section 64 and print section 65 can be displayed and printed.

The operation section 62 operates amounts per denomination based on the counted outputs of the respective type from the number counting section 61. The amount per type is also displayed and printed on the display section 64 and print section 65. Moreover, the addition section 63 adds the amounts of respective denominations so as to calculate a total amount. The total amount is also displayed and printed on the display section 64 and print section 65.

(8) Constitution of the Type Discriminating Section 45

The following will describe the type discriminating section 45 of the detection section 13. Fig. 5 shows the type discriminating section 45. In Fig. 5, the type discriminating

section 45 is composed of encoders 67 and 68, an addition circuit 69, a decoder 70, a width abnormal detecting section 71, a skew detecting section 72 and the like. The encoder 67 represents how many photo-diodes are covered by paper currency using a 4-bit binary number based on the output of the left photo-diode array 37. An output of the 4-bit binary number is transmitted to the addition circuit 69 and an AND circuit 73 of the detecting section 72. Moreover, the other encoder 68 generates an output of a 4-bit binary number as to the right photo-diode array 38, and it transmits the output of the binary number to the addition circuit 69 and another AND circuit 74 of the skew detecting section 72.

The addition circuit 69 is a 4-bit binary number addition circuit, and adds the outputs of the encoders 67 and 68. In the case where a correcting signal COMP is generated from the skewed feeding detecting section 47, the addition circuit 69 directly outputs the added result. Moreover, in the case where a correcting signal COMP is not generated from the skewed feeding detecting section 47, the addition circuit 69 adds "+1" to the above added result. When both ends of paper currency covers from L-10 to R-12 as shown by an alternate long and short dash line, for example, "10 + 12 + 1" is operated.

A signal of a terminal S5 of the addition circuit 69 is transmitted to one input terminal of an OR circuit 76 of the width abnormal detecting section 71 via an inverter 75. Moreover, a signal of a terminal S4 is transmitted directly to the other input terminal of the OR circuit 76. Further, the signal of the terminal S4 and signals of terminals S3, S2 and S1 are transmitted to the decoder 70. The decoder 70 generates a decoded output corresponding to that the sixteen through twenty-three photo-diodes are covered by paper currency based on a 4-bit signal from the addition circuit 69. The decoded output is transmitted as the discrimination signals JUD1 through JUD4 to the different type discriminating section 57 and the like via an OR circuit 77.

Here, also when the seven photo-diodes on the left side are covered by paper currency, the decoded output, which is

similar to the above case where the sixteen through twenty-three photo-diodes are covered, is outputted from the decoder 70. However, in this case, since the signal of the terminal S5 of the addition circuit 69 is "L" (a carrier output is not generated), the width abnormal detecting section 71, mentioned later, generates a width abnormal signal WID so that discrimination is canceled. Therefore, an mis-discrimination can be prevented.

Here, the following tables 1 and 2 show a relationship that what discrimination signal is generated when which photo-diodes of the photo-diode arrays 37 and 38 are covered. The Table 1 shows a case where paper currency is transported normally, and the Table 2 shows a case where paper currency is transported with it being skewed slightly and thus the discrimination is corrected.

Here, A corresponds discrimination of a five-hundred yen bill, B, C and D correspond respectively to discrimination of a thousand yen bill, five-thousand yen bill and ten-thousand yen bill, and E corresponds to an error.

Table 1

Table 2

The width abnormal detecting section 71 is composed of an OR circuit 76, an AND circuit 78 and a flip-flop 79. When the signal of the terminal S5 of the addition circuit 69 is "L" (in the case where only zero to fifteen photo-diodes are covered by paper currency because the paper currency is a half bill or the like), or when the signal of the terminal S4 is "H" (in the case where twenty-four or more photo-diodes are covered by paper currency because paper currency is linked), the flip-flop 79 is set at the timing of the timing pulse TP1. An output Q of the flip-flop 79 is transmitted to the OR circuit 51 (Fig. 2) as the width abnormal signal WID.

The skew detecting section 72 is composed of AND circuits 73, 74 and 80, an OR circuit 81 and a flip-flop 82. When paper currency is shifted to the left side of Fig. 4 and all the photo-diodes of the photo-diode array 37 are covered by the paper currency, the AND circuit 73 generates an output. Similarly, when paper currency is shifted to the right side of Fig. 4, the

AND circuit 74 generates an output. In the above-mentioned cases, the flip-flop 82 is set at the timing of the timing pulse TP1. An output Q of the flip-flop 82 is transmitted to the OR circuit 51 (Fig. 2) as an skew signal AFD.

The description about the constitution of the paper currency counter according to the present embodiment is completed.

There will be described below an operation of the paper currency counter according to the present embodiment.

(1) Different Type Detection Mode

At first, the description will be given as to an operation of the different type detection mode. In Figs. 1 and 2, the mode switch 17 is operated so that a mode signal OKM is generated. Then, the reference type setting input section 55 is operated so that a reference type signal BST is inputted to the reference type setting section 56 and a reference type is set. Thereafter, paper currency is placed on the paper feeding pedestal 18, and counting is started. As a result, the paper currency is transported to the separating mechanism 5 so as to be separated one by one. The separated paper currency is transported to the later stage by the transporting mechanism 6, and various detections as to the paper currency are executed here. The paper currency is accumulated into the stacking box 11 or is rejected based on the detections.

At first, a type of the transported paper currency is discriminated, and the discrimination signal JUD is transmitted to the different type detecting section 57 and gate control section 53.

On the other hand, when paper currency is shifted or is a half bill or linked or double feeding occurs or great skewed feeding occurs, such states are detected so that an error signal ERR is transmitted to the reject driving section 16 and gate control section 53. For this reason, a lock signal LOCK is transmitted from the flip-flop 60 of the reject driving section 16 to the reject fork driving control section 50, and as a result, even if the timing pulse TP5 is inputted, the reject fork driving

control section 50 does not energize the fork solenoid 35. Therefore, the reject fork 31 is still pressed to the counterclockwise direction as shown in Fig. 2, and the paper currency on which an error occurs is sorted to the reject mechanism 7 so as to be transported into the reject box 12.

In addition, since the error signal ERR is transmitted to the gate control section 53, even if a type of the paper currency is discriminated and the judgment signal JUD is transmitted to the gate control section 53, the timing pulse TP5 is not inputted into the number counting section 61. Therefore, the paper currency, which was rejected as mentioned above, is not counted.

On the other hand, in the case where a type of the transporting paper currency is a different type, the different type detecting section 57 transmits a different type signal DIF to the reject driving section 16 and gate control section 53 based on the discrimination signal JUD and reference type signal BST. Therefore, similarly to the above case where the error signal ERR is generated, the paper currency is rejected, and a number and the like of the rejected paper currency are not calculated.

In addition, in the case where the paper currency is a normal bill and an error in the transportation of the paper currency does not occur (including the case where the paper currency is transported with it being skewed but a correction can be made), the timing pulse TP3 is transmitted to the number counting section 61 according to the discrimination signal JUD. Hereinafter, every time the regular paper currency is transported normally, the timing pulse TP3 is transmitted to the number counting section 61, and a number, amount and the like of the regular paper currency are displayed and printed by the display section 64 and print section 65.

Here, in the above explanation, the reference type was set by the reference type setting input section 55, but a type of the paper currency, which is transported first from paper currency to be counted, can be inputted to the reference type setting section 56 based on a latch signal TPL of the latch timing control section 52. In this case, the mode switch 17 is operated

so that a mode signal OKM is outputted. As a result, the reference type can be set automatically when the reference type is not set by the reference type setting input section 55.

(2) Amount Calculation Mode

The following will describe the amount calculation mode. In this case, the mode switch 17 is operated so that a mode signal TPM is generated. Thereafter, paper currency is placed on the paper feeding pedestal 18, and counting is started. As a result, similarly to the case of the above different type detection mode, the paper currency is transported one by one to the transporting mechanism 6 so that various detections as to the paper currency are executed.

Incidentally, in the amount calculation mode, even if a different type signal DIF is inputted into one input terminal of the AND circuit 58, since a signal of "1" is not transmitted to the other input terminal, rejection is not executed when a different type is detected. Namely, even in the case where a type of paper currency is any type of paper currency, the paper currency is transported directly into the stacking box 11 unless an error in the transportation of the paper currency occurs.

In addition, in the amount calculation mode, the timing pulse TP3 is transmitted to the number counting section 61 according to the discrimination signal JUD regardless of existence and non-existence of the different type signal DIF. Therefore, a number, amount and the like per type are displayed and printed on the display section 64 and print section 65.

The explanation about the operation of the paper currency counter according to the present embodiment is completed.

There will be described below effects of the present embodiment. The effects of the present embodiment are as follows.

(1) A type of paper currency can be discriminated accurately and at a high speed by the simple structure.

(2) When the mode switch is operated, a different type of paper currency can be rejected, and a number and amount per type can be calculated and displayed.

(3) When an error in the transportation of paper currency occurs, the paper currency is rejected so that mis-discrimination is not executed.

(4) When paper currency is transported with it being skewed slightly, the discrimination is corrected so that the accurate discrimination can be executed.

Here, in the aforementioned embodiment, when an error occurs and a different type of paper currency is transported, the paper currency is rejected. However, the present invention is not limited to this, and as shown in Fig. 6, the reject mechanism may be omitted. Instead of this, when an error occurs and a different type of paper currency is transported, the counting can be stopped. In order to attain such an arrangement, in Fig. 2, the output of the OR circuit 54 may be transmitted as a stop signal CSP to a feeding/transportation driving section 83 as represented by a broken line.

The feeding/transportation driving section 83 transmits driving of a motor or the like via an electro-magnetic clutch/timing belt or the like based on a counting start signal CST so as to drive the feeding, and cuts off the transmission of the driving of the motor based on a counting stop signal CSP. Here, the stop signal CSP is used also for stopping the counting when a set number is counted and stopping the counting when all discharged paper currency is counted. Moreover, the stop signal CSP is used also for manual stop by means of a stop button or the like and stop when jam occurs.

As explained in the embodiment, according to the present invention, in the type discrimination apparatus of a paper sheets counter which separates laminated sheets one by one so as to transport them at predetermined intervals, and counts a number of the sheets during the process of the transportation, a width of the sheets in a direction being at right angles to the transportation direction is detected optically, and a type is discriminated based on the detection. Therefore, the type discrimination apparatus, which can execute discrimination accurately and at a high speed, can be realized by the simple

structure. Moreover, when a different type of sheets transported, the sheets can be rejected or the counting can be stopped by using the type discrimination apparatus. Further, a number, amount and the like for respective types can be calculated by using the type discrimination apparatus.

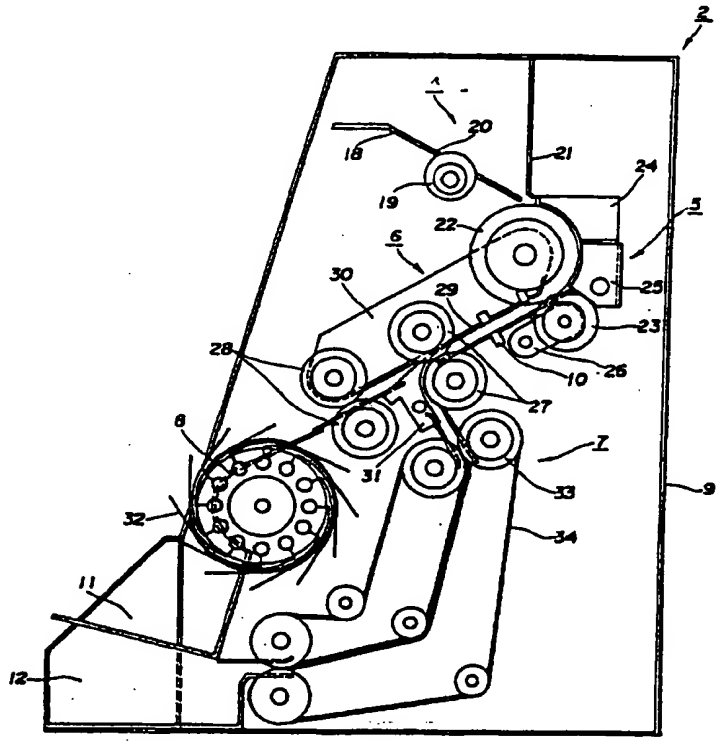
4. BRIEF DESCRIPTION OF THE DRAWINGS

The drawings show the paper currency counter according to one embodiment of the present invention: Fig. 1 is a schematic drawing showing the mechanism section 2; Fig. 2 is a block diagram showing the circuit section 3; Fig. 3 is a drawing showing the arrangement of the sensor section 10; Fig. 4 is a drawing showing the arrangement of the photo-diode arrays 37 and 38; Fig. 5 is a block diagram showing a detail of the type discriminating section 45 of Fig. 2; and Fig. 6 is a schematic drawing showing the mechanism section according to a modified example.

3……circuit section, 10……sensor section, 13……detection section, 36……type discrimination sensor, 37 and 38…… photo-diode array, 45……type discriminating section

Applicant: Laurel Bank Machine Corporation
Representative: Masatake Shiga Patent Attorney

Fig. 1



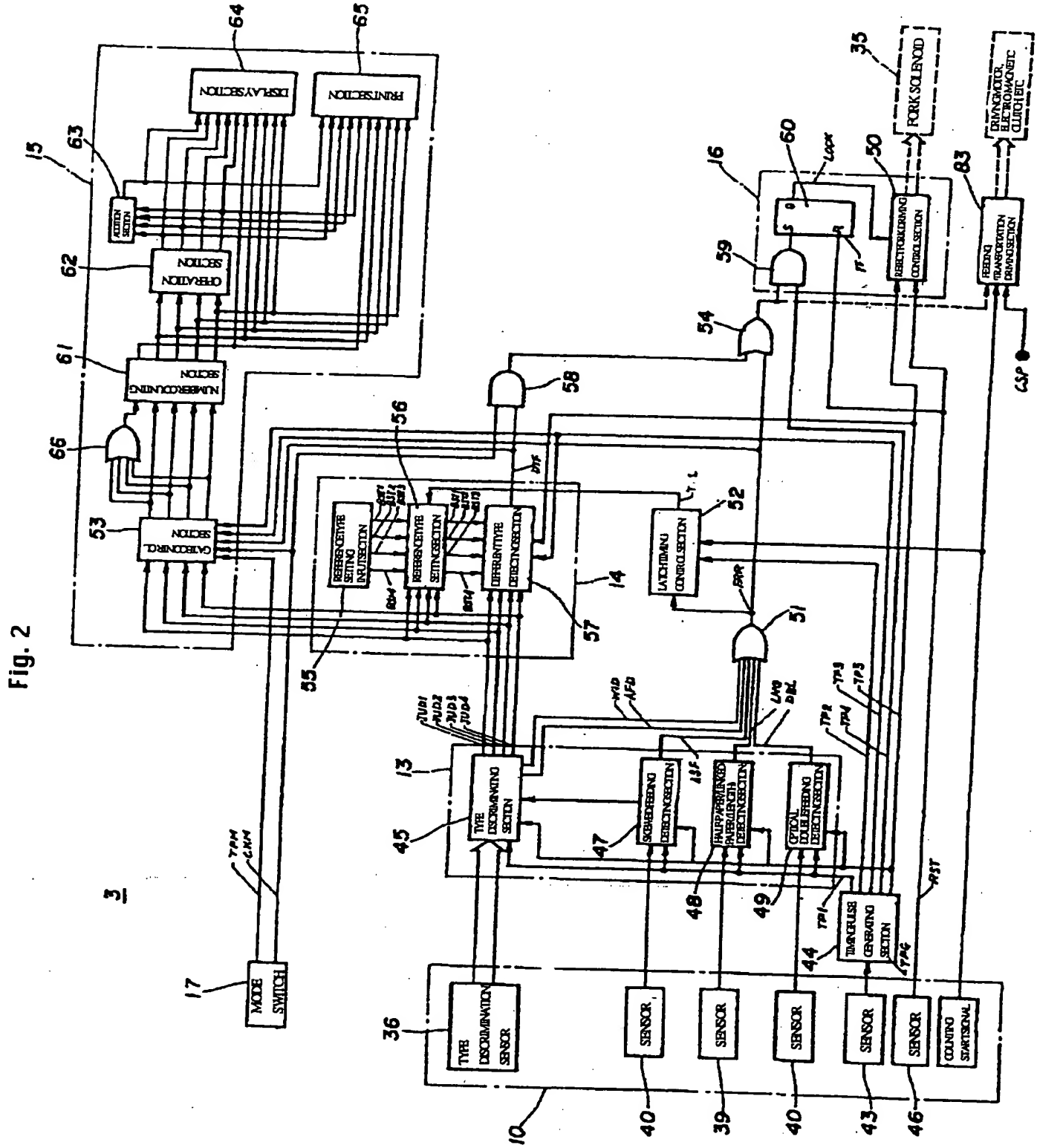

DISPLAY SECTION
PRINT SECTION
OPERATION SECTION
NUMBER COUNTING SECTION
CATEGORIZING SECTION
REFERENCE TYPE SETTING (ADJUSTMENT) SECTION
REFERENCE TYPE SETTING SECTION
DIFFERENT TYPE DETECTION SECTION
LATCH TIMING CONTROL SECTION
TYPE DISCRIMINATING SECTION
SCRATCH FEEDING DETECTION SECTION
HALF PENNY FEEDING DETECTION SECTION
OPTICAL DOUBLE FEEDING DETECTION SECTION
TRIANGULUSE GENERATING SECTION
FEEDING TRANSMISSION DRIVING SECTION
REJECTION DRIVING CONTROL SECTION
FORK SOLENOID
DRIVING MOTOR, ELECTROMAGNETIC CLUTCH ETC
MODE SWITCH
TYPE DISCRIMINATION SENSOR
SENSOR
COUNTING START SIGNAL

Fig. 2

Fig. 3

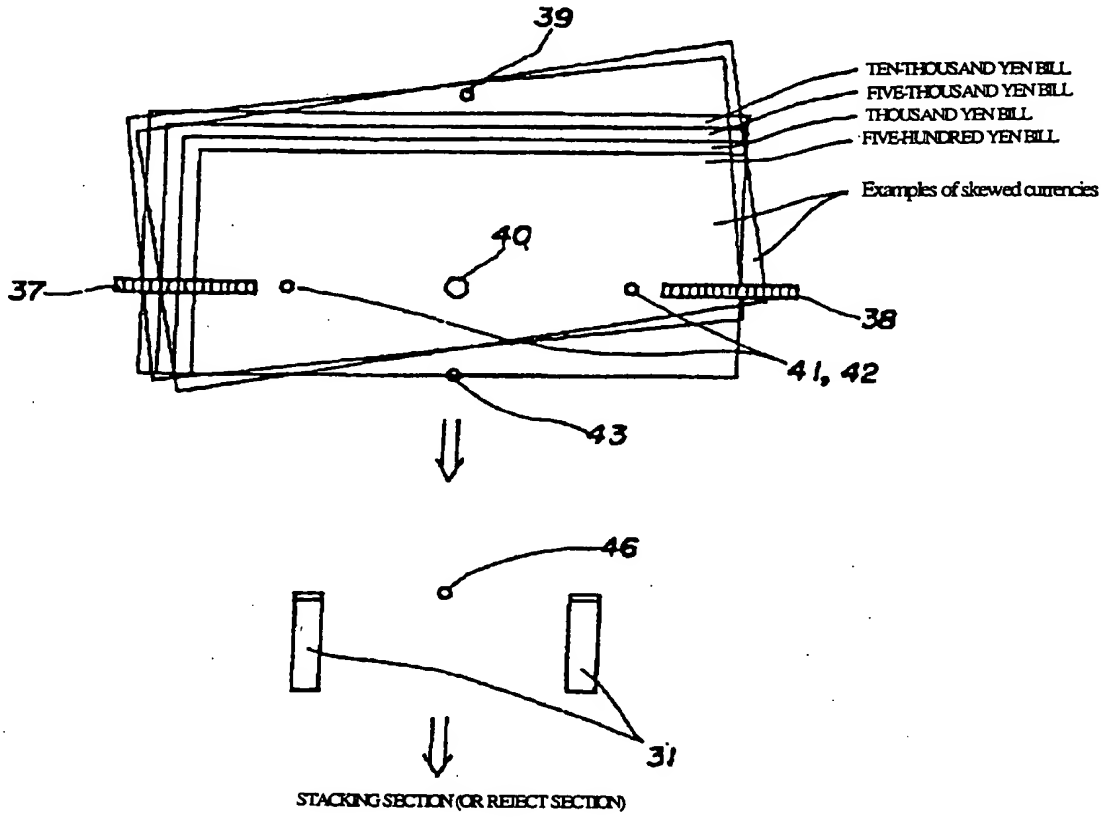
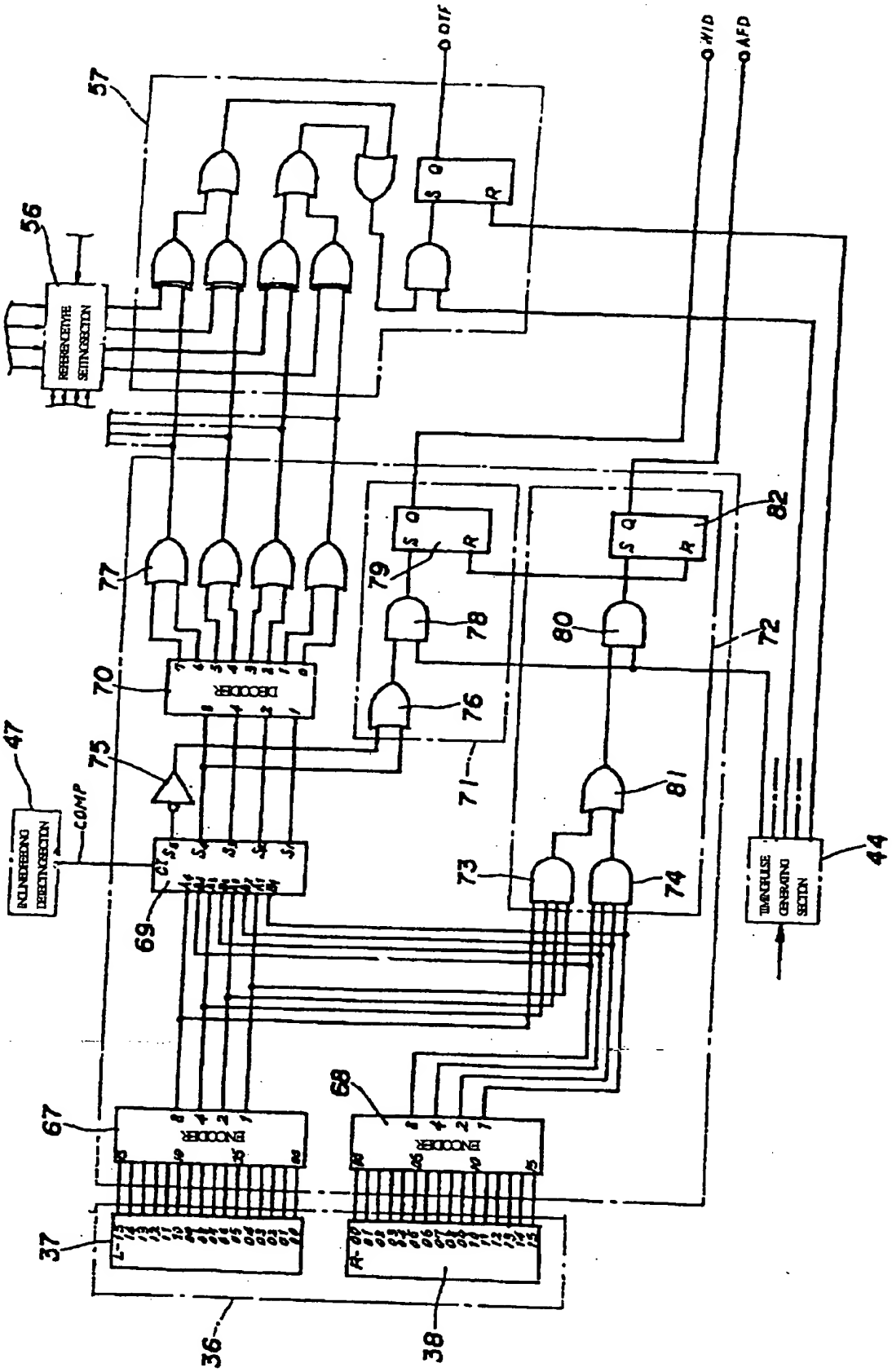

39
TEN-THOUSAND YEN BILL
FIVE-THOUSAND YEN BILL
THOUSAND YEN BILL
FIVE-HUNDRED YEN BILL
Examples of skewed currencies
40
37
38
41, 42
43
46
31
STACKING SECTION (OR REJECT SECTION)

Fig. 5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ENCODER
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Fig. 4

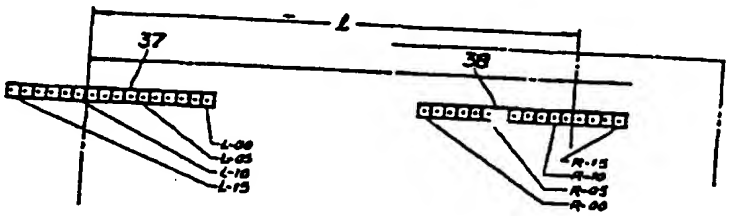

Fig. 6